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Singaraju

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(54) **ESCALATOR SYSTEM WITH SAFETY SENSOR**

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(51) **Int. Cl.**

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B66B 23/24	(2006.01)
B66B 31/02	(2006.01)
B66B 21/02	(2006.01)

(52) **U.S. Cl.**

CPC ***B66B 29/005*** (2013.01); ***B66B 23/24*** (2013.01); ***B66B 31/02*** (2013.01); *B66B 21/02* (2013.01)

(58) **Field of Classification Search**

CPC B66B 31/02; B66B 21/02; B66B 23/24; B66B 29/005
USPC 198/322
See application file for complete search history.

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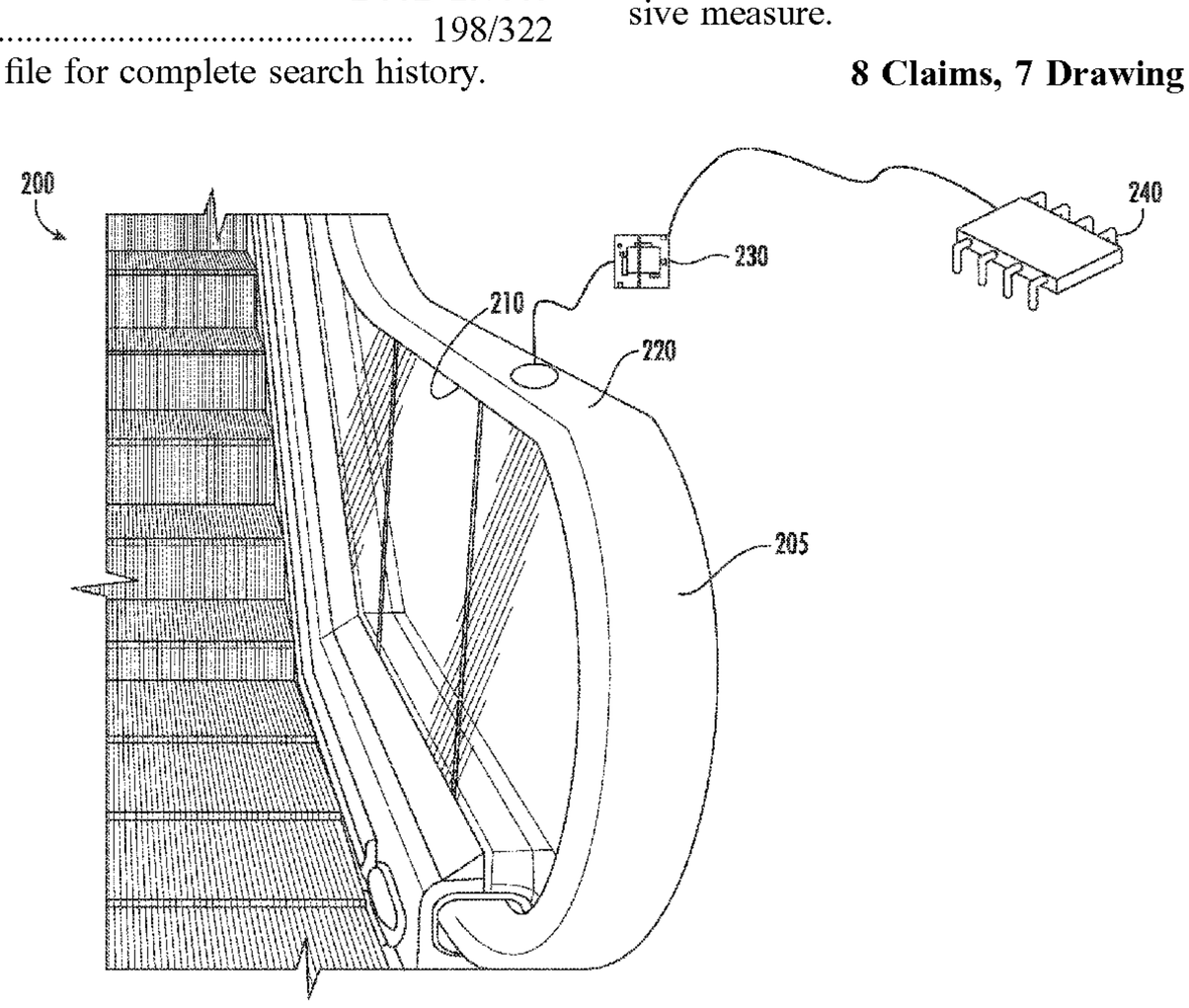
(57) **ABSTRACT**

Disclosed is an escalator system including handrail, the system having: a handrail including a handrail base and a handrail cover operationally connected to the handrail base, a first sensor disposed between the handrail base and the handrail cover and a first controller for controlling the first sensor, and wherein the first sensor processes data representing a sensed parameter, whereby the system identifies the occurrence of a trigger event and executes a first responsive measure.

8 Claims, 7 Drawing Sheets



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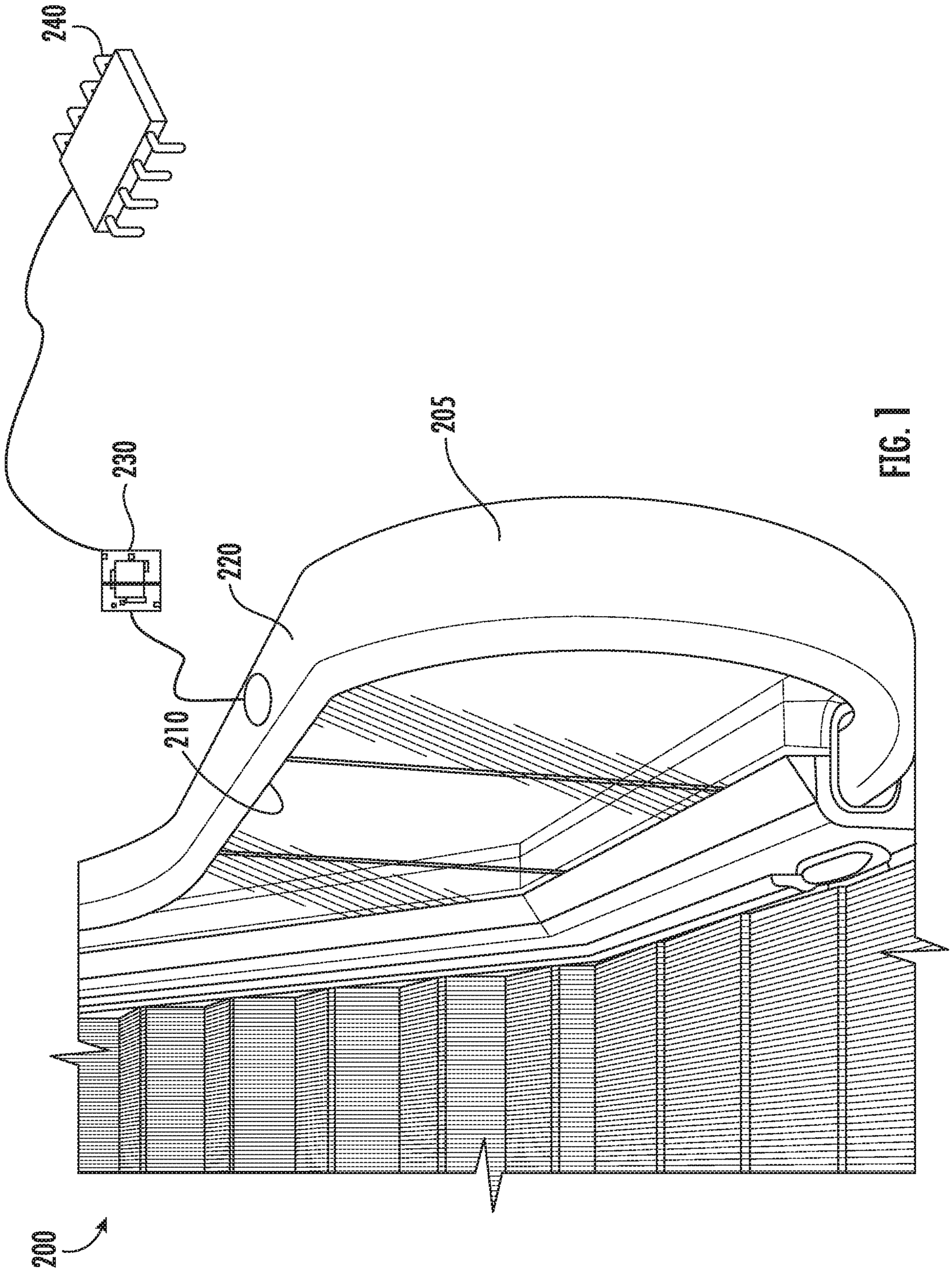

FIG. 1

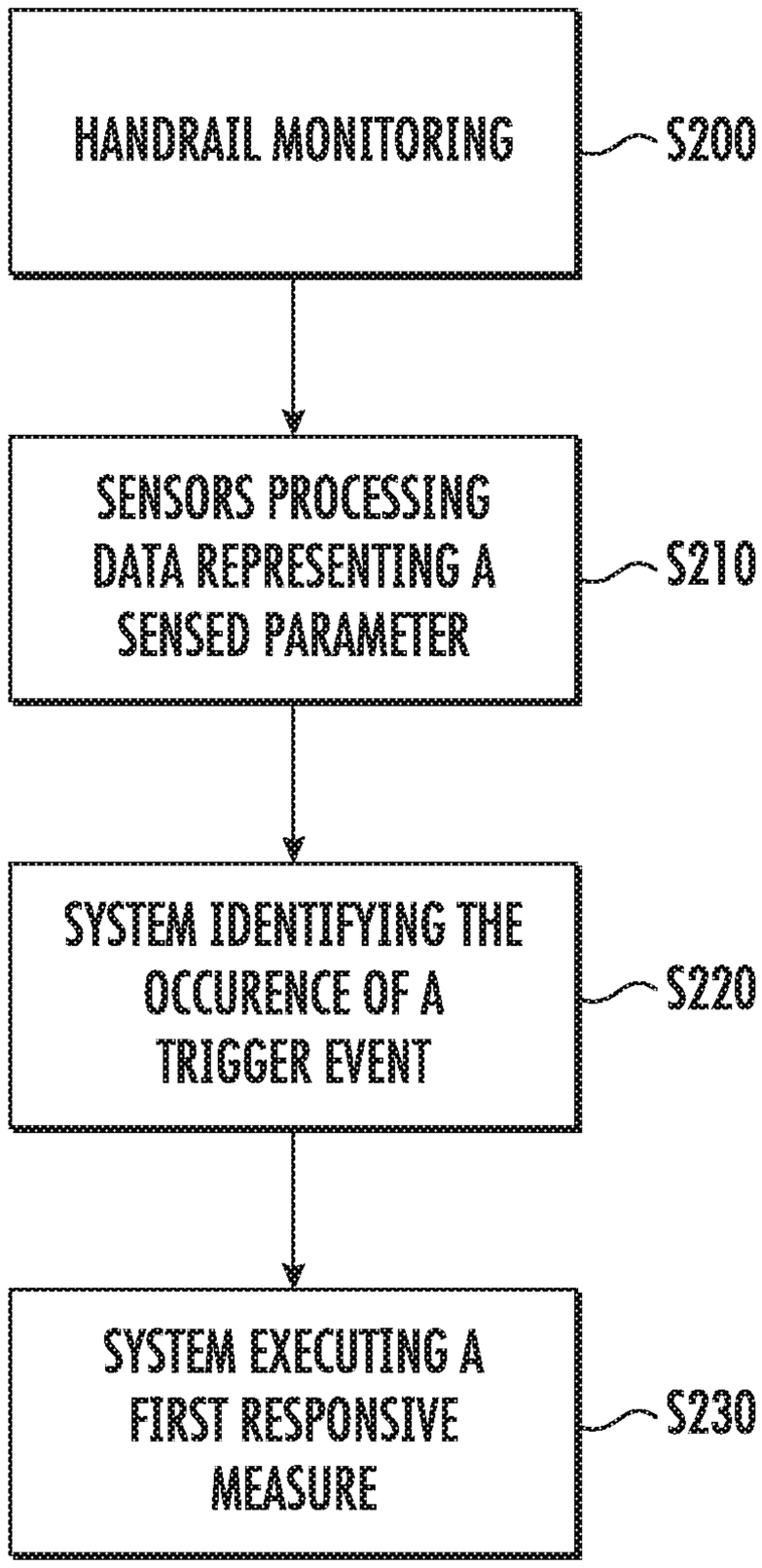
HANDRAIL MONITORING
S200
SENSORS PROCESSING DATA REPRESENTING A SENSED PARAMETER
S210
SYSTEM IDENTIFYING THE OCCURENCE OF A TRIGGER EVENT
S220
SYSTEM EXECUTING A FIRST RESPONSIVE MEASURE
S230

FIG. 2

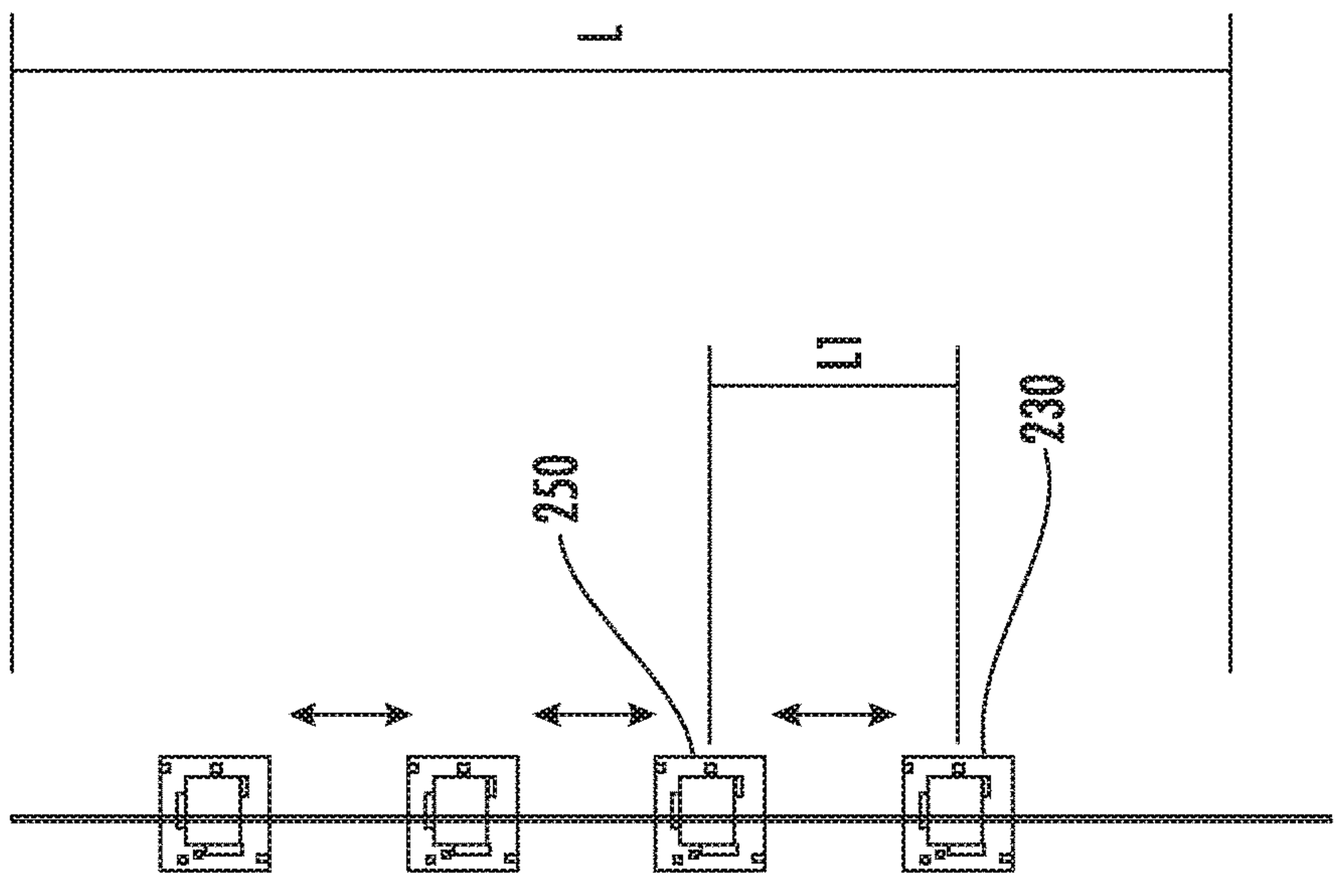

FIG. 4

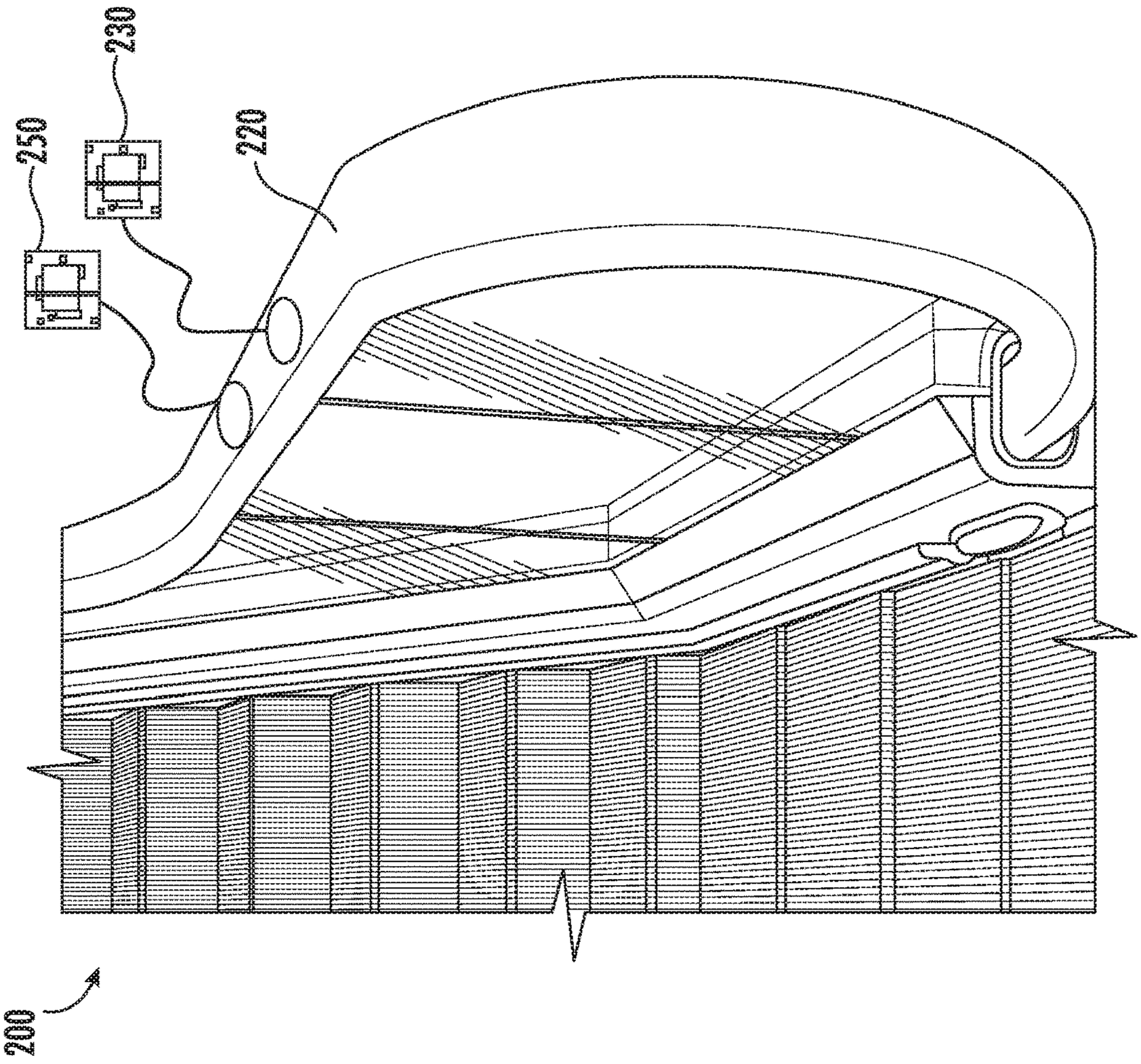

FIG. 3

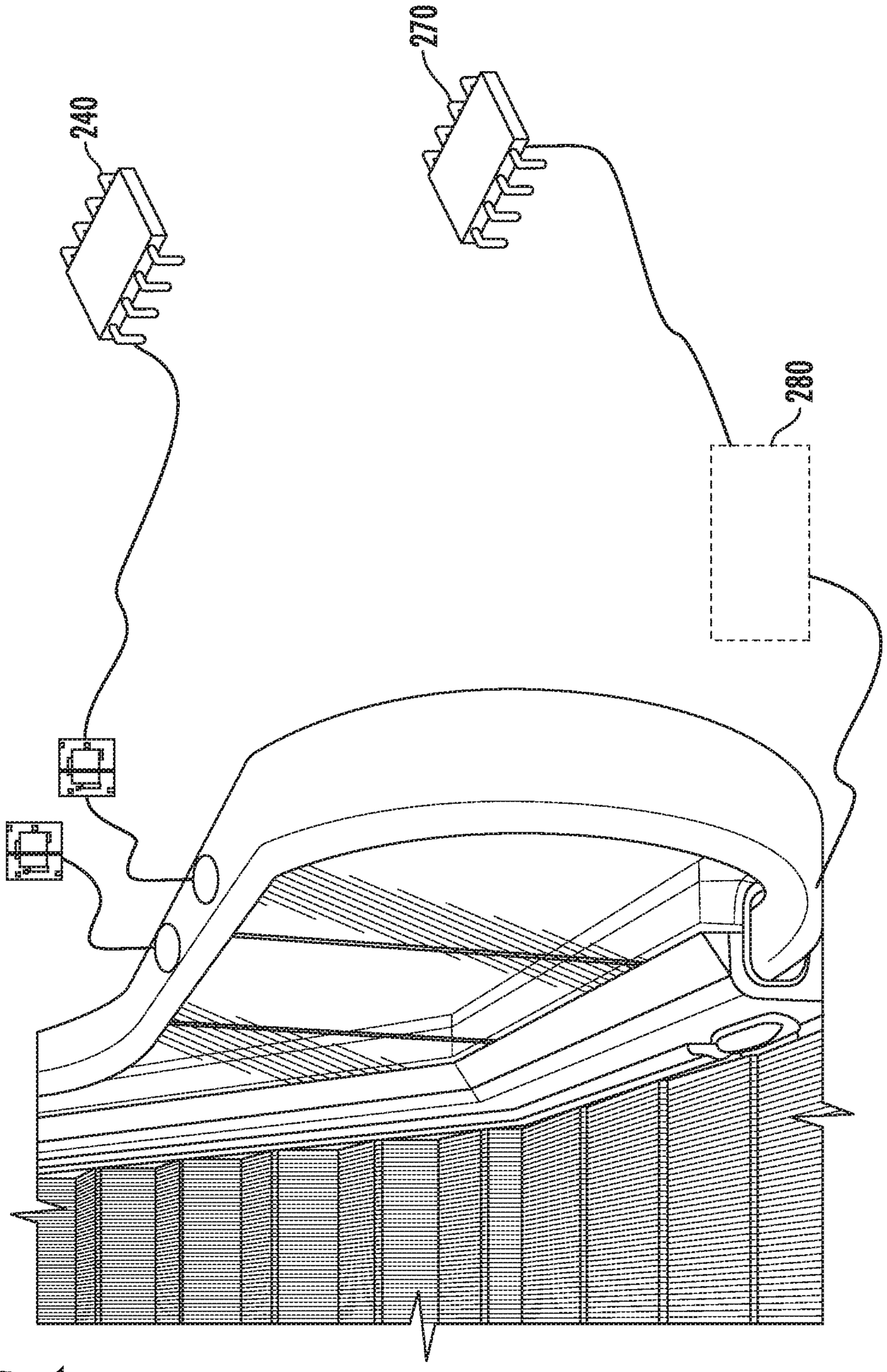

FIG. 5

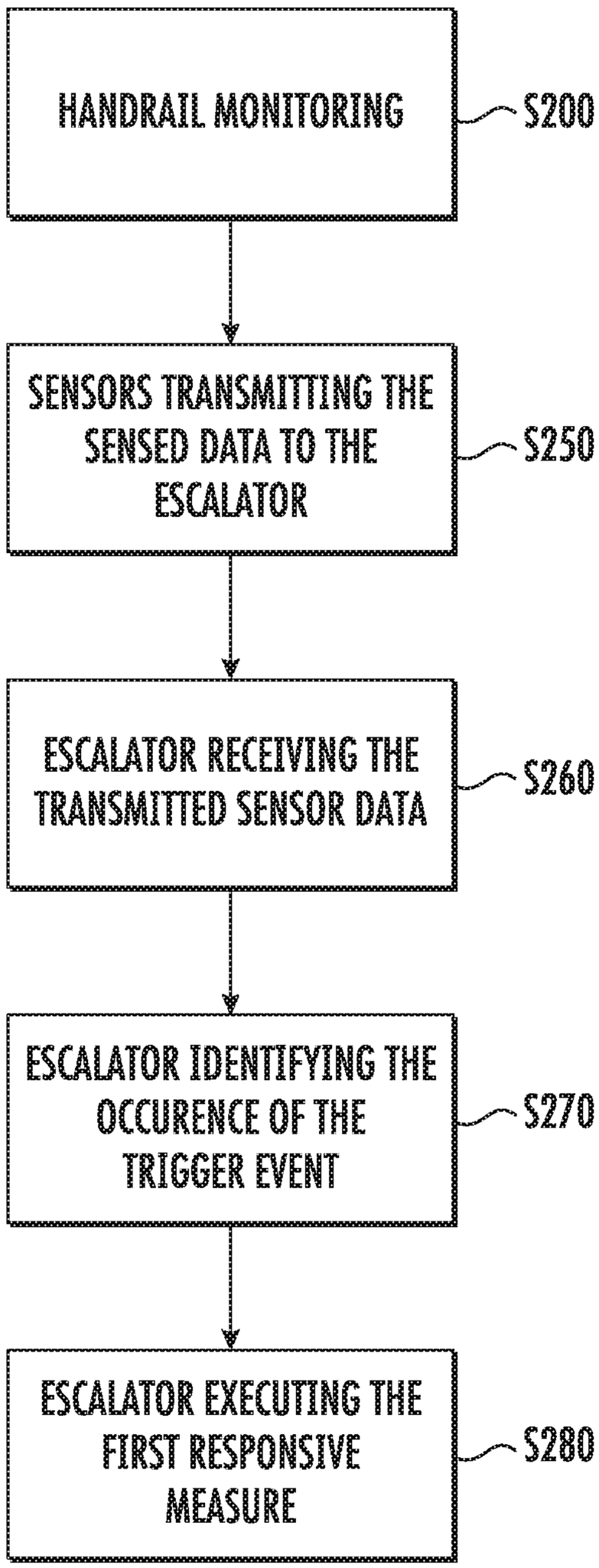
HANDRAIL MONITORING
S200
SENSORS TRANSMITTING THE SENSED DATA TO THE ESCALATOR
S250
ESCALATOR RECEIVING THE TRANSMITTED SENSOR DATA
S260
ESCALATOR IDENTIFYING THE OCCURENCE OF THE TRIGGER EVENT
S270
ESCALATOR EXECUTING THE FIRST RESPONSIVE MEASURE
S280

FIG. 6

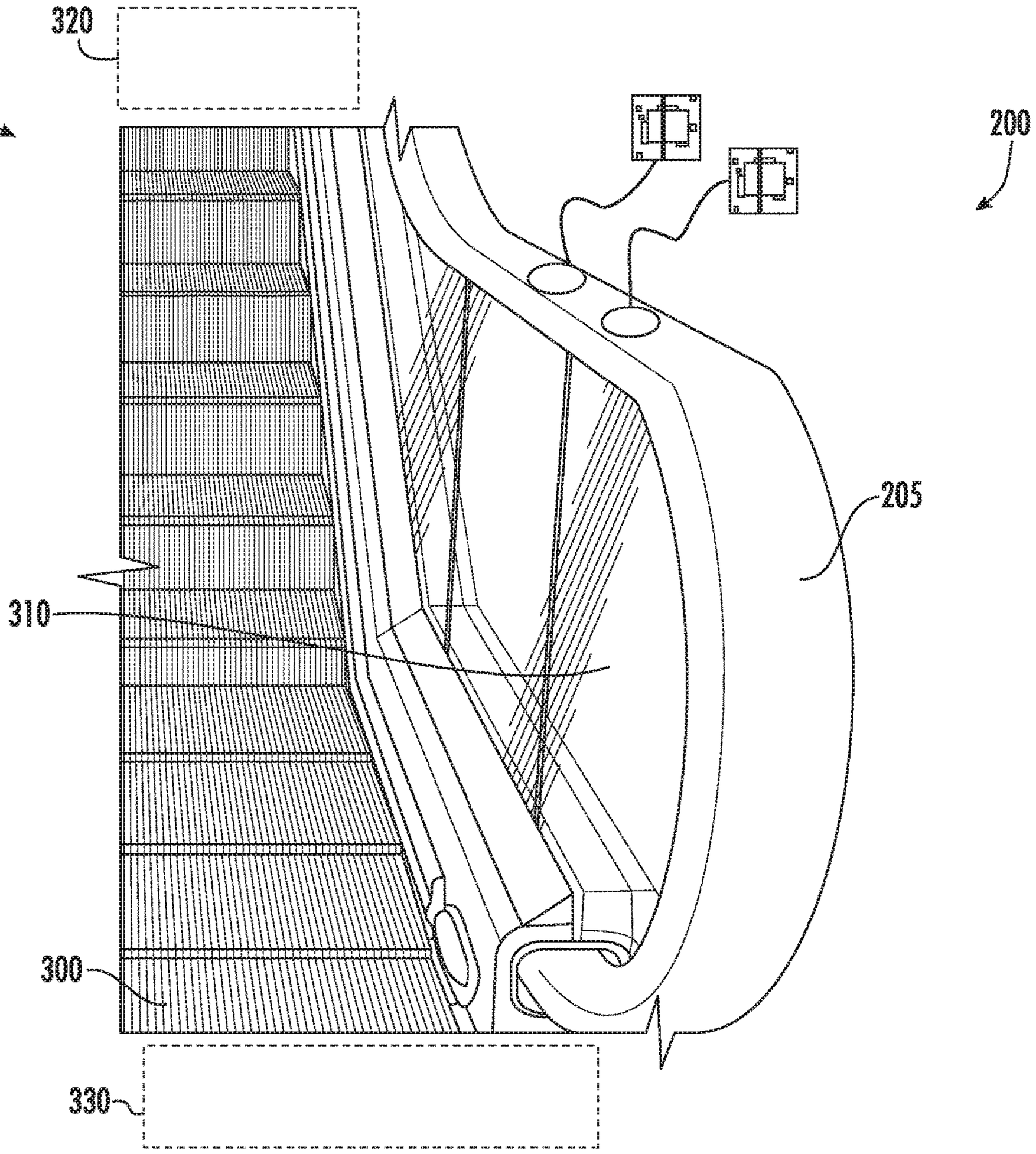

FIG. 7

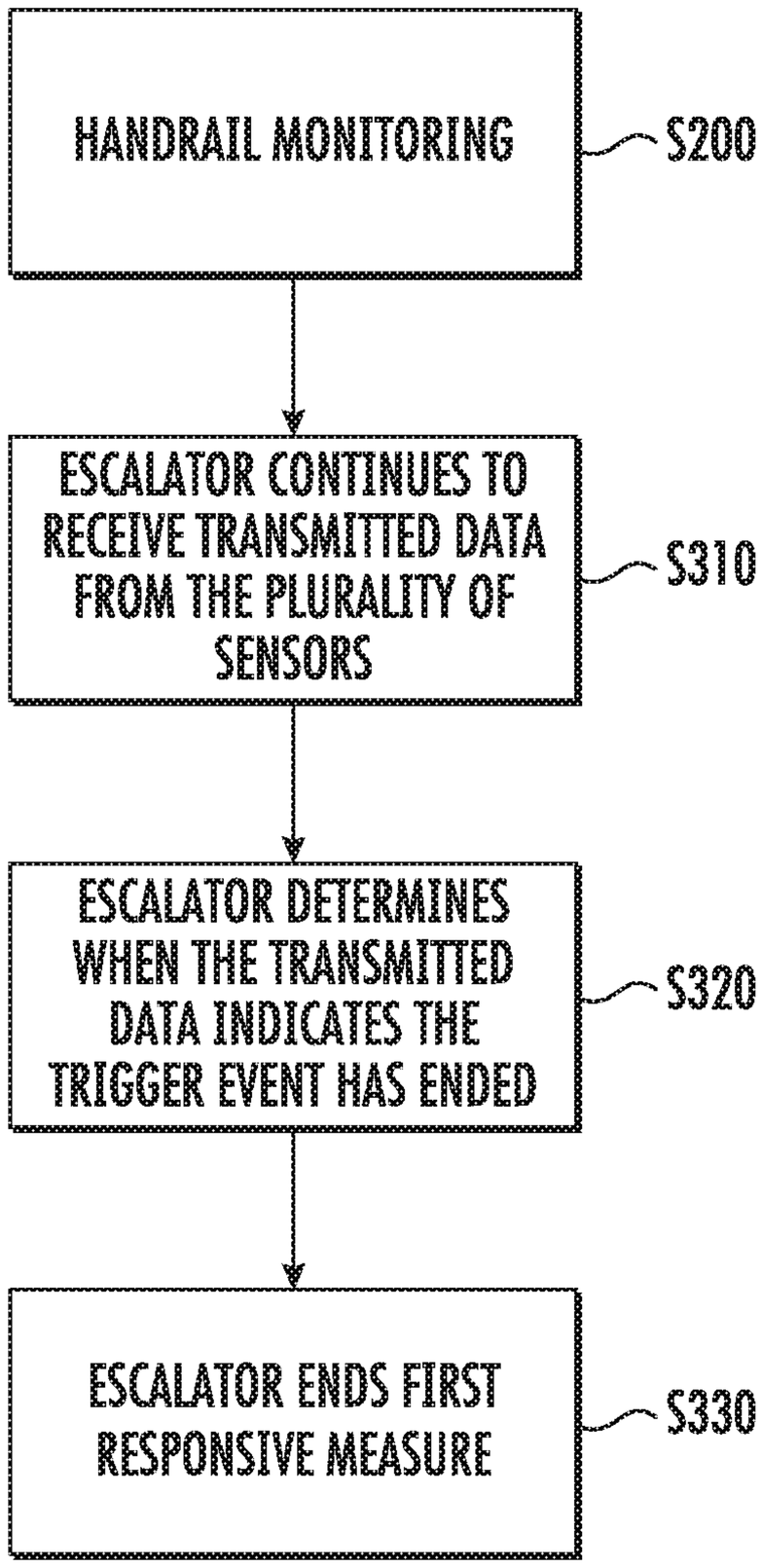
HANDRAIL MONITORING
S200
ESCALATOR CONTINUES TO RECEIVE TRANSMITTED DATA FROM THE PLURALITY OF SENSORS
S310
ESCALATOR DETERMINES WHEN THE TRANSMITTED DATA INDICATES THE TRIGGER EVENT HAS ENDED
S320
ESCALATOR ENDS FIRST RESPONSIVE MEASURE
S330

FIG. 8

ESCALATOR SYSTEM WITH SAFETY SENSOR

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Indian Patent Application No. 201811030190, filed Aug. 10, 2018, which is hereby incorporated by reference in its entirety.

BACKGROUND

The embodiments herein relate to operation of an escalator system and more specifically to an escalator system with one or more safety sensors.

Escalator safety related incidents are known to occur based on passenger behavior, including when adults and children lean on an escalator handrail. Handrails may malfunction as a result of such misuse.

BRIEF SUMMARY

Disclosed is an escalator system including handrail, the system comprising: a handrail including a handrail base and a handrail cover operationally connected to the handrail base, a first sensor disposed between the handrail base and the handrail cover and a first controller for controlling the first sensor, and wherein the first sensor processes data representing a sensed parameter, whereby the system identifies the occurrence of a trigger event and executes a first responsive measure.

In addition to one or more of the above disclosed features and elements, or as an alternate, the sensed parameter is one or more of pressure, force, weight, impulse and displacement.

In addition to one or more of the above disclosed features and elements, or as an alternate, the system identifies the occurrence of a trigger event when system determines that data processed by the first sensor indicates the sensed parameter applied to the handrail cover is greater than an acceptable limit.

In addition to one or more of the above disclosed features and elements, or as an alternate, the system comprises a plurality of sensors including the first sensor and a second sensor, the plurality of sensors being spaced on the handrail cover, and wherein the plurality of sensors processes data representing the sensed parameter, whereby the system identifies the occurrence of the trigger event.

In addition to one or more of the above disclosed features and elements, or as an alternate, the system identifies the occurrence of the trigger event when the system determines that data processed by the first sensor and the second sensor indicate the sensed parameter applied to the handrail cover is greater than the acceptable limit.

In addition to one or more of the above disclosed features and elements, or as an alternate, the first sensor and second sensor are lengthwise adjacent along a lengthwise span of the handrail cover.

In addition to one or more of the above disclosed features and elements, or as an alternate, the plurality of sensors are mutually spaced by a same spacing interval.

In addition to one or more of the above disclosed features and elements, or as an alternate, the system comprises an escalator, a plurality of controllers including the first controller and a second controller, the second controller being an escalator controller that operationally controls the escalator and communicates with the plurality of sensors,

wherein the plurality of sensors processes the sensed data by transmitting the sensed data to the escalator controller, and the escalator controller receives the transmitted sensor data, identifies the occurrence of the trigger event, and executes the first responsive measure, and wherein the first responsive measure is one or more of stopping the escalator and providing an alert.

In addition to one or more of the above disclosed features and elements, or as an alternate, the escalator comprises a plurality of escalator components, including: steps, the handrail assembly, a balustrade supporting the handrail assembly, a plurality of landings including a top landing and a bottom landing, and the first responsive measure includes providing the alert, the alert being a visual alert and/or an audible alert, wherein the alert is provided on one or more of the plurality of escalator components.

In addition to one or more of the above disclosed features and elements, or as an alternate, while executing the first responsive measure, the escalator monitors handrail status may continue to receive transmitted data from the plurality of sensors, identify an ending of the trigger event, and thereafter end the first responsive measure.

Further disclosed is a method of operating a handrail for an escalator system, the system having one or more of the above disclosed features and elements.

The foregoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated otherwise. These features and elements as well as the operation thereof will become more apparent in light of the following description and the accompanying drawings. It should be understood, however, that the following description and drawings are intended to be illustrative and explanatory in nature and non-limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure is illustrated by way of example and not limited in the accompanying figures in which like reference numerals indicate similar elements.

FIG. **1** illustrates components of an escalator system according to an embodiment;

FIG. **2** illustrates a process related to the components in FIG. **1**;

FIG. **3** illustrates further components of an escalator system according to an embodiment;

FIG. **4** illustrates further components of an escalator system according to an embodiment;

FIG. **5** illustrates further components of an escalator system according to an embodiment;

FIG. **6** illustrates a process related to the components in FIG. **5**;

FIG. **7** illustrates further components of an escalator system according to an embodiment; and

FIG. **8** illustrates a process related to the components in FIG. **7**.

DETAILED DESCRIPTION

Turning to FIG. **1**, disclosed is an escalator system **200**. The system **200** may comprise a handrail assembly **205** that includes a handrail base **210** and a handrail cover **220** operationally connected to the handrail base **210**. Not disclosed herein are typical components of a handrail base **210**, including a slider, tension member disposed exterior to the slider, and inner components disposed exterior to the tension member. The system **200** may include a first sensor **230** disposed between the handrail base **210** and the handrail

cover **220**, and a first controller **240** for controlling the first sensor **230**. The first controller **240** may be an on-board controller for the first sensor **230**.

Reference in this document to operational features of the first sensor **230** may also be construed as reference to the first controller **240** for implementing controls necessary to support such operational features. Other components and related controllers disclosed herein shall be similarly construed.

Turning to FIG. **2**, disclosed is process S**200** of handrail monitoring by the system **200**. Process steps are sequentially numbered in this document to facilitate discussion but are not intended to identify a specific sequence of preformation such steps or a requirement to perform such steps unless expressly indicated. The first sensor **230** may perform step S**210** of processing data representing a sensed parameter. The sensed parameter may be one or more of pressure, force, weight, impulse and displacement. From this transmission, the system **200** may perform step S**220** of identifying the occurrence of a trigger event. Thereafter the system **200** may perform step S**230** of executing a first responsive measure.

More specifically, the system **200** may identify the occurrence of a trigger event when the system **200** determines that data processed by the first sensor **230** indicates the sensed parameter applied to the handrail cover **220** is greater than an acceptable limit. For example, a predetermined limit for applied weight may be a certain number of pounds. Accordingly, a trigger event may occur when the system **200** identifies the applied weight sensed by the first sensor **230** is, for example, one or more pounds above the predetermined limit.

Turning to FIG. **3**, the system **200** may include a plurality of sensors, including the first sensor **230** and a second sensor **250**, spaced on the handrail cover **220**. The plurality of sensors may be operationally the same as the first sensor **230**. According to an embodiment the plurality of sensors may process data representing the sensed parameter. From this data the system **200** may identify the occurrence of the trigger event. According to an embodiment, the system **200** may determine that data processed by the first sensor **230** and the second sensor **250** indicate the sensed parameter applied to the handrail cover is greater than the acceptable limit.

As illustrated in FIG. **4**, the first sensor **230** and second sensor **250** may be lengthwise adjacent along a lengthwise span L of the handrail cover **220**. According to an embodiment the plurality of sensors may be mutually spaced by a same spacing interval L**1**. The spacing interval L**1** may be for example three inches, though such increment is not intended to be limiting.

Turning to FIG. **5**, the system **200** may include an escalator **260**. In addition, the system **200** may include a plurality of controllers including the first controller **240** and a second controller **270**. The second controller **270** may be an escalator controller that controls operational parameters of the escalator **260** and communicates with the plurality of sensors. The second controller **270** may be housed, for example, within an electronic control hub **280**, illustrated schematically, housed within or proximate to the escalator **260**.

Turning to FIG. **6**, for the monitoring process S**200**, the plurality of sensors processes the sensed data at step S**250** by transmitting the sensed data to the escalator **260**. The escalator **260** performs step S**260** of receiving the transmitted sensor data, step S**270** of identifying the occurrence of the trigger event, and step S**280** of executing the first responsive measure. According to an embodiment the first responsive measure executed by the escalator **260** may be one or more of stopping the escalator **260** and providing an alert.

Turning to FIG. **7**, the escalator **260** may comprise a plurality of escalator components, including steps **300**, the handrail assembly **205**, a balustrade **310** supporting the handrail assembly **205**, and a plurality of landings including a top landing **320** and a bottom landing **330**, both illustrated schematically. Not illustrated herein are typical internal support structures for the steps **300**, including a track disposed on a truss.

According to an embodiment the first responsive measure may include providing the alert, wherein the alert being a visual alert and/or an audible alert, and wherein the alert is provided from one or more of the escalator components. For example, speakers and/or a series of lights may be integrated into the escalator components such as the steps **300**, the balustrade **310**, the handrail cover **220** or other part of the handrail assembly **205**, and the landings. The escalator **260** may stop the handrail and/or provide an alert including one or more of a tone, verbal warning and flashing lights, to indicate when the trigger event has occurred. Passengers, alerted to the trigger event, may then use the handrail assembly appropriately in order to end the trigger event.

Turning to FIG. **8**, the handrail monitoring process S**200** may include additional steps while effecting the first responsive measure. At step S**310** the escalator **260** may continue to receive transmitted data from the plurality of sensors. At step S**320** the escalator **260** may determine when the transmitted data indicates the trigger event has ended. For example, the transmitted data may indicate that the sensed parameter applied to the handrail cover **220** is below the acceptable limit. Then at step S**330** the escalator **260** may end the first responsive measure. That is, the escalator **260** may resume normal operation.

The above disclosed embodiments provide a safeguard for passengers and handrail equipment using weight-force-pressure sensing devices between a handrail and handrail base. A multiple of such devices may be placed at mutually equivalent distances. The sensing devices may sense the weight-force application by passengers on the handrail. A default weight-force input at each sensor device may be configured for certain limits. When the weight from two or more consecutive sensing devices is more than the configured limits, an additional force may be acting on handrail. For example, passengers may be leaning on a handrail for support or, for example, children attempting to play. The disclosed embodiments may provide safeguard that prevents damage from occurring to the handrail and injuries from occurring to passengers.

The above disclosed embodiments provide a handrail movement that may be suspended to avoid damage to the handrail and injury to passengers. The disclosed embodiments may provide an alarm that is sounded so that other passengers and perhaps security personnel may be alerted to assist in the safeguarding process both for the equipment and themselves.

The above disclosed system comprises a conveyance system that moves passengers between floors and/or along a single floor. Such conveyance systems are identified herein as escalators, however other application to other forms of people movers is considered within the scope of the disclosure.

As described above, embodiments can be in the form of processor-implemented processes and devices for practicing those processes, such as a processor. Embodiments can also be in the form of computer program code containing instruc-

tions embodied in tangible media, such as network cloud storage, SD cards, flash drives, floppy diskettes, CD ROMs, hard drives, or any other computer-readable storage medium, wherein, when the computer program code is loaded into and executed by a computer, the computer becomes a device for practicing the embodiments. Embodiments can also be in the form of computer program code, for example, whether stored in a storage medium, loaded into and/or executed by a computer, or transmitted over some transmission medium, loaded into and/or executed by a computer, or transmitted over some transmission medium, such as over electrical wiring or cabling, through fiber optics, or via electromagnetic radiation, wherein, when the computer program code is loaded into an executed by a computer, the computer becomes an device for practicing the embodiments. When implemented on a general-purpose microprocessor, the computer program code segments configure the microprocessor to create specific logic circuits.

The term "about" is intended to include the degree of error associated with measurement of the particular quantity and/or manufacturing tolerances based upon the equipment available at the time of filing the application.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, element components, and/or groups thereof.

Those of skill in the art will appreciate that various example embodiments are shown and described herein, each having certain features in the particular embodiments, but the present disclosure is not thus limited. Rather, the present disclosure can be modified to incorporate any number of variations, alterations, substitutions, combinations, subcombinations, or equivalent arrangements not heretofore described, but which are commensurate with the scope of the present disclosure. Additionally, while various embodiments of the present disclosure have been described, it is to be understood that aspects of the present disclosure may include only some of the described embodiments. Accordingly, the present disclosure is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

What is claimed is:

1. An escalator system comprising:

a handrail including a handrail base and a handrail cover operationally connected to the handrail base,

a first sensor disposed between the handrail base and the handrail cover and a first controller for controlling the first sensor, and

wherein the first sensor processes data representing a sensed parameter, whereby the system identifies the occurrence of a trigger event and executes a first responsive measure, and

wherein:

the sensed parameter is one or more of pressure, force, weight, impulse and displacement;

the system includes a plurality of sensors, including the first sensor and a second sensor, the plurality of sensors being disposed between the handrail base and the handrail cover and lengthwise spaced along a lengthwise span of the handrail cover by a same spacing interval so that the first sensor and second sensor are lengthwise adjacent along the lengthwise span of the handrail cover,

the plurality of sensors processes data representing the sensed parameter, whereby the system identifies the occurrence of the trigger event, and the system identifies the occurrence of the trigger event when the system determines that data processed by two or more adjacent ones of the plurality sensor indicate the sensed parameter applied to the handrail cover is greater than the acceptable limit.

2. The system of claim **1**, comprising

an escalator,

a plurality of controllers including the first controller and a second controller, the second controller being an escalator controller that operationally controls the escalator and communicates with the plurality of sensors,

wherein the plurality of sensors processes the sensed data by transmitting the sensed data to the escalator controller, and the escalator controller receives the transmitted sensor data, identifies the occurrence of the trigger event, and executes the first responsive measure, and

wherein the first responsive measure is one or more of stopping the escalator and providing an alert.

3. The system of claim **2** wherein

the escalator comprises a plurality of escalator components, including:

steps,

the handrail assembly,

a balustrade supporting the handrail assembly,

a plurality of landings including a top landing and a bottom landing, and

the first responsive measure includes providing the alert, the alert being a visual alert and/or an audible alert, wherein the alert is provided on one or more of the plurality of escalator components.

4. The system of claim **3** wherein

while executing the first responsive measure, the escalator monitors handrail status to receive transmitted data from the plurality of sensors, identifies an ending of the trigger event, and thereafter ends the first responsive measure.

5. A method of operating a handrail for an escalator system, the system comprising:

a handrail assembly including a handrail base and a handrail cover operationally connected to the handrail base,

a first sensor disposed between the handrail base and the handrail cover and a first controller for controlling the first sensor, and

wherein the first sensor processes data representing a sensed parameter, whereby the system identifies the occurrence of a trigger event and executes a first responsive measure, and

wherein:

the sensed parameter is one or more of pressure, force, weight, impulse and displacement,

the system includes a plurality of sensors, including the first sensor and a second sensor, the plurality of sensors being lengthwise spaced on the handrail cover by a same spacing interval so that the first sensor and second sensor are lengthwise adjacent along a lengthwise span of the handrail cover,

the plurality of sensors processes data representing the sensed parameter, whereby the system identifies the

occurrence of the trigger event, and the system identifies the occurrence of the trigger event when the system determines that data processed by two or more adjacent ones of the plurality sensor indicate the sensed parameter applied to the handrail cover is greater than the acceptable limit.

6. The method of claim **5** wherein the system comprises an escalator,

a plurality of controllers including the first controller and a second controller, the second controller being an escalator controller that operationally controls the escalator and communicates with the plurality of sensors,

wherein the plurality of sensors processes the sensed data by transmitting the sensed data to the escalator controller, and the escalator controller receives the transmitted sensor data, identifies the occurrence of the trigger event, and executes the first responsive measure, and

wherein the first responsive measure is one or more of stopping the escalator and providing an alert.

7. The method of claim **6** wherein

the escalator comprises a plurality of escalator components, including:

steps,

the handrail assembly,

a balustrade supporting the handrail assembly,

a plurality of landings including a top landing and a bottom landing, and

the first responsive measure includes providing the alert, the alert being a visual alert and/or an audible alert,

wherein the alert is provided on one or more of the plurality of escalator components.

8. The method of claim **7** wherein

while executing the first responsive measure, the escalator monitors handrail status to receive transmitted data from the plurality of sensors, identifies an ending of the trigger event, and thereafter ends the first responsive measure.

* * * * *